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THE

# JOHN MURRAY EXPEDITION 1933–34

## SCIENTIFIC REPORTS

VOLUME VI, No. 1

# REPORT ON THE ECHINOIDEA OF THE MURRAY EXPEDITION

## PART I

BY

TH. MORTENSEN

WITH TEN TEXT-FIGURES AND SIX PLATES

LONDON:
PRINTED BY ORDER OF THE TRUSTEES OF THE BRITISH MUSEUM
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AND AT
THE BRITISH MUSEUM (NATURAL HISTORY), CROMWELL ROAD, LONDON, S.W.7
1939

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Price Five Shillings

[*Issued 28th October*, 1939]

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# REPORT ON THE ECHINOIDEA OF THE MURRAY EXPEDITION

## PART I

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## INTRODUCTION.

THE Regular Echinoidea collected by the Murray Expedition number in all 35 species. In comparison with the number of species collected by the "Investigator", 50 species (less one—*Aspidodiadema annulatum*, which is a *Diadema*, probably *D. Savignyi*), the Murray collection lags somewhat behind. In regard to the Cidarids, however, it compares very favourably with the "Investigator" collection, containing no less than 12 species, as against 11 species in the "Investigator" collection; but whereas the "Investigator" collection contained only 2 new species, the present collection contains no less than 5 new species, one of them representing a new generic type, *Lissocidaris*. Two of the new species, *Cidaris mabahissæ* and *Lissocidaris fusca* are of very great zoogeographical interest, as they belong to the sub-family *Cidarina*, hitherto known only from the Atlantic. Another very interesting discovery is *Goniocidaris indica*, this genus, so richly developed in the Japanese-Malayan-Australian region, being not otherwise represented in the Indian Ocean. On the whole the Indian Ocean is very rich in Cidarids, comparing favourably with the Malay region, the richest in the world in this regard, and far surpassing the Atlantic and the West American region.

Among the Echinothurids *Arœosoma alternatum*, of which only a single specimen was known till now, is of considerable interest, and among the Diadematids *Centrostephanus nitidus* stands out as the most important.

The discussion of the zoogeographical problems will be included in Part II of this report; attention should here only be called to the rich fauna of deep-sea Echinoids in the Pemba Strait. It is regrettable that most of the specimens collected there, particularly the Echinothurids, are in a very poor state of preservation.

## List of the Species Collected.

| | |
|---|---|
| 1. *Histocidaris denticulata* Koehler . . | Maldives. |
| 2. *Goniocidaris indica* n. sp. . . . | Pemba Strait; Maldives. |
| 3. *Stereocidaris indica* Döderlein . . | Maldives. |
| 4. *St. squamosa* Mrtsn. . . | Pemba Strait. |
| 5. *St. reducta* n. sp. . . . | Maldives. |
| 6. *Cidaris mabahissæ* n. sp. . . . | Maldives. |
| 7. *Lissocidaris fusca* n. g., n. sp. . . | Maldives. |
| 8. *Stylocidaris bracteata*, var. *mauritiana* Mrtsn. | Cape Gardafui. |
| 9. *S. lævispina* n. sp. . . | Cape Gardafui. |
| 10. *Acanthocidaris curvatispinis* (Bell) . | Cape Gardafui. |
| 11. *Prionocidaris baculosa* (Lamk.) . . | S. of Arabia; Gulf of Persia. |
| 12. *P. pistillaris* (Lamk.) . . | Cape Gardafui. |
| 13. *Phormosoma bursarium* A. Agassiz . | Pemba Strait; Maldives; Gulf of Aden. |
| 14. *P. verticillatum* Mrtsn. . . | Maldives; Gulf of Aden. |
| 15. *Tromikosoma (?) uranus* (Wyv. Thoms.) | 1° 26′ S., 66° 34′ E. |
| 16. *Hygrosoma hoplacantha* (Wyv. Thoms.) . | Gulf of Aden; Pemba Strait; Maldives. |
| 17. *Sperosoma* sp. . . . . | Mombasa. |
| 18. *Arœosoma alternatum* Mrtsn. . . | Pemba Strait. |
| 19. *Asthenosoma varium* Grube . . . | Red Sea. |
| 20. *Salenocidaris miliaris*, var. *indica* n. var. | Maldives; Andamans. |
| 21. *Cœlopleurus Maillardi* (Michelin) . . | Cape Gardafui. |
| 22. *Diadema Savignyi* Michelin . . . | Cape Gardafui. |
| 23. *Chætodiadema africanum* H. L. Clark . | Pemba Strait. |
| 24. *Echinothrix calamaris* (Pallas). . . | Cape Gardafui. |
| 25. *Centrostephanus nitidus* Koehler . . | Maldives. |
| 26. *Micropyga violacea* de Meijere . . | Pemba Strait. |
| 27. *M. tuberculata* A. Agassiz . . . | Pemba Strait. |
| 28. *Plesiodiadema amphigymnum* (de Meijere) | Off Minikoi. |
| 29. *P. molle* (Döderlein) . . . . | 1° 26′ S., 66° 35′ E. |
| 30. *Salmacis erythracis* H. L. Clark . . | Cape Gardafui. |
| 31. *Temnopleurus Reevesii* (Gray) . . | Cape Gardafui. |
| 32. *T. apodus* (A. Ag. & H. L. Clark. . | Pemba Strait. |
| 33. *Temnotrema siamense* (Mrtsn.) . . | S. Arabia; Cape Gardafui; Pemba Strait. |
| 34. *T. scillæ* (Mazzetti) . . . . | S. Arabia. |
| 35. *Prionechinus Agassizi* Wood-Mason & Alcock. | Pemba Strait. |

### Family Cidaridæ.

#### *Histocidaris denticulata* Koehler.

*Histocidaris denticulata*, Koehler 1927, "Investigator" Ech. III, p. 10, pl. i, figs. 1–3, 6, 7, pl. ii, fig. 1, pl. xxiii, fig. 1; Mortensen, 1928, Monograph of the Ech. I, p. 100, pl. lxxv, figs. 14, 15, pl. lxxvii, fig. 19.

Occurrence.

St. 145, 2.iv.1934, 4° 59′ S., 73° 16′ E., 494 m., off the Maldives.* 3 specimens.

Descriptive Notes :

| H.d. mm. | V.d. mm. | Apical system. | Peristome. | Number of I.A. | Number of A. pro I.A. | Longest spines. |
|---|---|---|---|---|---|---|
| 80 | 71 | 29 mm. (36·2% h.d.) | 23 mm. (28·7% h.d.) | 12–13 | 11–12 | 152 mm. |
| 79 | 71 | 30 ,, (38 % ,, ) | 25 ,, (31·6 % ,, ) | 12 | 11–12 | 134 ,, |
| 66 | 58 | 26 ,, (39 % ,, ) | 20 ,, (30 % ,, ) | 11–12 | 11–12 | 124 ,, |

These specimens on the whole agree very completely with the description given by Koehler and the present author (*op. cit.*). It should only be pointed out that the oculars are only partly insert, viz., in Specimen 2 only Oc. I, in Specimen 1 Oc. I and V, and in Specimen 3 Oc. I, V and IV, the latter only just touching the periproct. In Specimen 1 the marginal ambulacral tubercles are rather irregular, in Specimen 2 very regular, in Specimen 3 somewhat intermediate.

The colour of all three specimens is a creamy white.

*Goniocidaris indica* n. sp. (Pl. I, figs. 1–4; Pl. V, figs. 4, 7; Pl. VI, figs. 17, 18.)

Occurrence.

St. 115, 15.i.1934, 5° 05′ S., 39° 22′ E., 640 m., between Pemba Island and the African continent. 7 specimens.

Descriptive Notes :

| H.d. mm. | V.d. mm. | Apical system. | Peristome. | Number of I.A. | Number of A. pro I.A. | Longest spines. |
|---|---|---|---|---|---|---|
| 25 | 17 | 12 mm. (48 % h.d.) | 9 mm. (36 % h.d.) | 7–8 | 9–10 | 44 mm. |
| 22 | 16 | 11·5 ,, (52·5% ,, ) | 9 ,, (40·9% ,, ) | 7–8 | 9–10 | 38 ,, |
| 20 | 13·5 | 10 ,, (50 % ,, ) | 8 ,, (40·9% ,, ) | 7–8 | 10–11 | 40 ,, |
| 16 | 11 | 8 ,, (50 % ,, ) | 6·5 ,, (40·6% ,, ) | 7 | 7–8 | 35 ,, |

*Shape of test* low, rounded, usually somewhat flattened above and below; in one specimen, however, the apical system rises gently, in continuation of the rounding of the test, the shape being thus almost spherical; but even in this latter specimen the oral side is somewhat flattened.

*Ambulacra* fairly broad, *c.* 40% the width of the interambulacra; in the largest specimen they are, however, only *c.* 33%. They are rather distinctly sinuate. Interporiferous zone somewhat more than twice the width of a pore-zone. Marginal series of tubercles quite regular, the tubercles not contiguous, there being even a couple of small miliary tubercles between them. Inside the marginal tubercles the plates wholly covered by a number (*c.* 4–6) of small irregularly arranged tubercles. The admedian end of the horizontal sutures sunken, forming distinct pits, which may be connected by a distinctly

* The labels of two of the specimens give the station number 146, but the depth 510 m. According to the published Station List St. 146 has a depth of only 37 m. There can thus be no doubt that 146 is erroneous, and that all three specimens came from the same station, 145. The error in the station number is probably due to the fact that two hauls were made at the same station, 145, at the same depth. That the depth given on the labels as 510 m. in the published Station List as 494 m. is another slight discrepancy, fortunately of no importance, and is due to the fact that the greater depth, noted on the label and given by the Echo-sounder, was provisional, and was subsequently corrected for salinity and temperature.

sunken median line. The pores small, round ; the wall elevated, the ridge rather low. (Pl. V, fig. 4.)

*Interambulacra.*—Areoles rather small, conspicuously sunken ; only the two lowermost confluent. The scrobicular tubercles fairly conspicuous, the plates outside the scrobicular circle closely covered by small tubercles, leaving no naked median line. The admedian end of the horizontal sutures deepened so as to form distinct pits.

*Apical system.*—All oculars exsert. Genital pores in the males situated about in the middle of the genital plates, in the females near the distal edge, or even rupturing the edge. One specimen is abnormal in having 2–3 pores in three of the genital plates (Pl. I, fig. 1 ; Text-fig. 1). The whole apical system rather closely covered by small tubercles, leaving only a more or less conspicuous bare edge (Text-fig. 2). *Peristome* distinctly smaller than

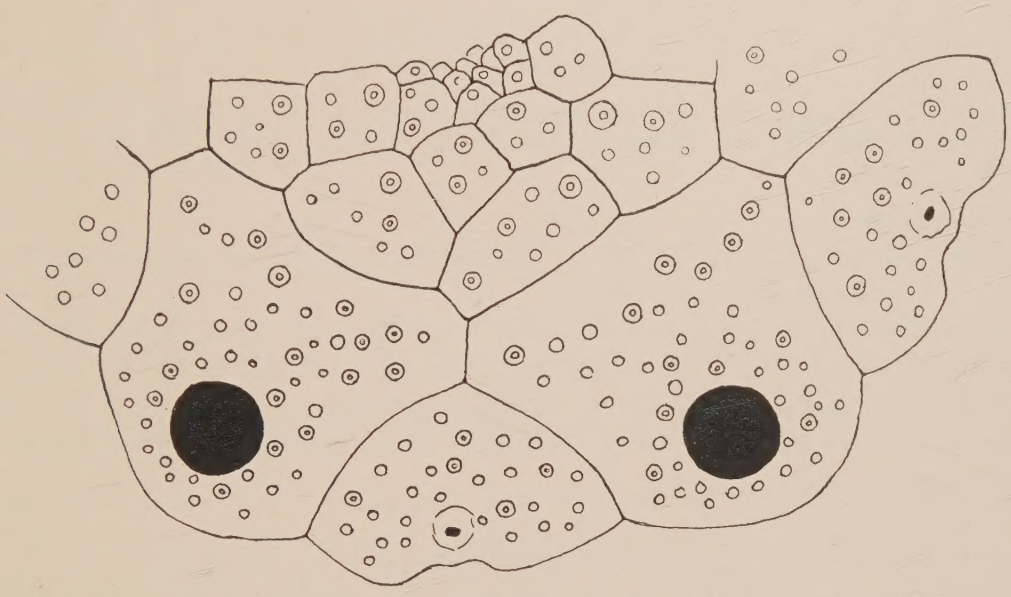
TEXT-FIG. 1.—Part of the apical system of *Goniocidaris indica*, with multiple genital pores. Male specimen. × 12.

the apical system ; it is perfectly flat. There are 5–6 ambulacral plates in a series, 3–4 interradial plates ; in the largest specimen these latter plates are somewhat irregular, the 2nd and 3rd plate being divided into two.

*Primary spines c.* $1\frac{1}{2}$–2 times the h.d. They are slender, tapering to a point, rarely a very small terminal crown on some of the ambital spines. They appear nearly smooth, the low thorns being (in not too much worn spines) almost hidden in the dense coat of anastomosing hairs. The basal disc is well developed on the adapical side of the larger ambital spines. The uppermost primaries are widened into a broad, flat disc ; it is excentrical, the adapical side being the broader. The edge of the disc appears to be entire on the fully formed discs, whereas in the not fully formed it is deeply serrate. One of the smaller specimens has 6 apical discs, which means that when full-grown this specimen would have had 10 discs ; whether this will be the rule in this species cannot be stated definitely, the material available being not sufficiently well preserved, several of the adapical spines

having been lost; but it rather seems that as a rule there are only 5 adapical discs also in the adult. The discs have a not very dense coat of simple hairs on the upper side. The adoral primaries are slender, a little curved, smooth, with an indication of lateral serrations; the third is more distinctly serrate and, together with the fourth, forms the transition to the ambital spines. *Secondary spines*: The scrobicular spines are *c.* 2 mm. long, rather thick, smooth, almost rectangular. The marginal ambulacral spines much like the scrobicular ones, only more slender and a little shorter. The miliary spines are erect, not pointed.

*Pedicellariæ.*—No large globiferous pedicellariæ found on any of the specimens. The small globiferous well developed; the valves are rather elongate, with a small end-tooth (Pl. VI, figs. 17, 18). Tridentate pedicellariæ of the large coarse form (Pl. V, fig. 7), fairly common in some of the specimens. *Spicules* of the tube-feet nearly smooth rods.



TEXT-FIG. 2.—Part of apical system of *Goniocidaris indica*. Female specimen. × 12.

*Colour.*—Primary spines white, secondaries straw-coloured. Also the denuded test is of a light straw-colour, not pure white.

*Biology.*—As usual, the primary spines are covered by various foreign organisms—worm-tubes, hydroids (in tufts at the point of the spines), a white Scalpellid (mainly on the apical discs). Also an Ophiurid (*Ophiacantha* sp.) was found between the spines on one of the specimens.

*Remarks.*—It is clear that this species belongs to the *Aspidocidaris* group within the great genus *Goniocidaris*, and that it is particularly related to *Goniocidaris Sibogæ* Mrtsn. from the Malay Archipelago. It differs from it, as also from the related Japanese species *Goniocidaris alba* Mrtsn., mainly by its more slender and much more smooth primary spines. Also its darker colour makes a conspicuous difference, the two said species being a pure white. Possibly, if we had specimens from intermediate localities, we should have to regard all these three species as local variations of one and the same species; but as long as we know one only from Japan, the other from the Malay Archipelago, and the third from the western part of the Indian Ocean, we are not justified in neglecting the small differences that exist and combining them all together into one species.

In my Monograph I, p. 154, Note 2, mention is made of the existence in S. African Seas (off Cape St. Blaize, Mossel Bay) of a *Goniocidaris* apparently allied to *G. fimbriata* (de Meijere). There can hardly be any doubt but that it will prove to be identical with the present species, which will no doubt be found to occur all along the East African coast.

The genus *Goniocidaris* being otherwise confined to the Japanese, Malayan and Australian–New Zealand seas, represented there by a considerable number of species, it is of very great zoogeographical interest that a species of the genus has now been found to exist in the western part of the Indian Ocean, not a single species having hitherto been found in the whole of the Indian Ocean. It would be of very great interest to know whether the species is confined to the western part or whether it is distributed all over the Indian Ocean. In any case the centre of the genus *Goniocidaris* is in the Malay Archipelago, from whence this Indian Ocean species represents an isolated radiation.

### *Stereocidaris indica* Döderlein.

*Stereocidaris indica* Döderlein, 1906, Ech. Deutsche Tiefsee-Exped., p. 104, taf. x, figs. 1,2, taf. xi, figs. 1–6 and taf. xii, figs. 3–10, etc. ; Mortensen, 1928, Monogr. Ech. I, p. 263, pl. xxv, fig. 1, and pl. lxxi, figs. 4, 5, etc.

Occurrence :

St. 143, 30.iii.1934, 5° 16′ S., 73° 23′ E., 797 m., off Maldive Archipelago, 1 specimen.

The specimen is abnormal and in a poor state of preservation, nearly all the larger primary spines being lost. It is impossible to decide to which of the diverse varieties established by Döderlein this specimen should be referred. I rather think it is the var. *africana*, but do not venture to say so definitely. None of the spines preserved have any wing-like crests.

### *Stereocidaris squamosa* Mrtsn. (Pl. IV, figs. 2, 3.)

*Stereocidaris squamosa* Mortensen, 1928, Monogr. Ech. I, p. 245, pl. xx, figs. 4–6, pl. lxx, fig. 7 and pl. lxxx, figs. 10–16 ; 1932, New Contrib. Knowl. Cidarids, p. 151.

Occurrence :

St. 109, 13.i.1934, 5° 11′ S., 39° 34′ E., 640 m., strait between Pemba Island and the African continent. 1 specimen.

This is an adult specimen, 44 mm. h.d., in fair condition. The specimen figured in my monograph having lost most of its primary spines, I have thought it desirable to give photographic figures of the present specimen, which convey a better impression of what the species looks like.

The specimen differs from the type in the interporiferous zone being wholly covered by secondary tubercles, each plate carrying 2–3 smaller tubercles adradially to the marginal one, instead of one relatively large one, as shown in pl. lxx, fig. 7, of the Monograph. Also in the colour of the test it differs slightly from the type in there being scarcely any trace of a greenish tint.

To the statement in the description of this species (Monograph, p. 246) that the primary spines on the whole give the impression of being very smooth it should be added that this holds good mainly of the better preserved spines, in which the hair coat is left intact. Where the hair coat has been lost, as is the case of most of the spines of the present

specimen, the spines show rather distinct longitudinal lines of small, low serrations. One of the upper spines has a fairly conspicuous terminal crown. The longest spines are *c.* 75 mm., thus about $1\frac{2}{3}$ the h.d.

On the present specimen the peristome is deeply sunken, particularly in the interambulacra, so that it gives almost the impression of there being five interradial pouches. This tends to suggest that this species may be brood-protecting, carrying its young ones on the peristome ; I think, however, that the sunken condition of the peristome is due to the specimen having been left lying dry on deck for some time before being preserved in alcohol. There are, at any rate no young ones on the present specimen (or on any of the other specimens I have examined ; judging from the size of the genital pores the present specimen is a female).

*Stereocidaris reducta* n. sp. (Pl. II, figs. 1–4 ; Pl. V, fig. 1 ; Pl. VI, figs. 14–16.)

Occurrence :

St. 157, 6.iv.1934, 4° 44′ N., 72° 55′ E., 229 m., off Maldive Islands. 4 specimens.

Descriptive Notes :

| H.d. mm. | V.d. mm. | Apical system. | Peristome. | Number of I.A. | Number of A. pro I.A. | Longest spines. |
|---|---|---|---|---|---|---|
| 64 | 43 | 26 mm. (40·6% h.d.) | 27 mm. (42 % h.d.) | (6) 7 | 21–24 | 60 mm. |
| 61 | 44 | 26 ,, (42·6% ,, ) | 25 ,, (45·9% ,, ) | 6–7 | 22–26 | 68 ,, |
| 58 | 41 | 24 ,, (41·4% ,, ) | 24 ,, (41·4% ,, ) | 6–7 | 21–25 | 52 ,, |
| 56 | 45 | 21 ,, (37·4% ,, ) | 23 ,, (41·1% ,, ) | 6–7 | 21–23 | 54 ,, |

*Shape of the test* almost spherical, only the oral side more or less depressed, though not flattened.

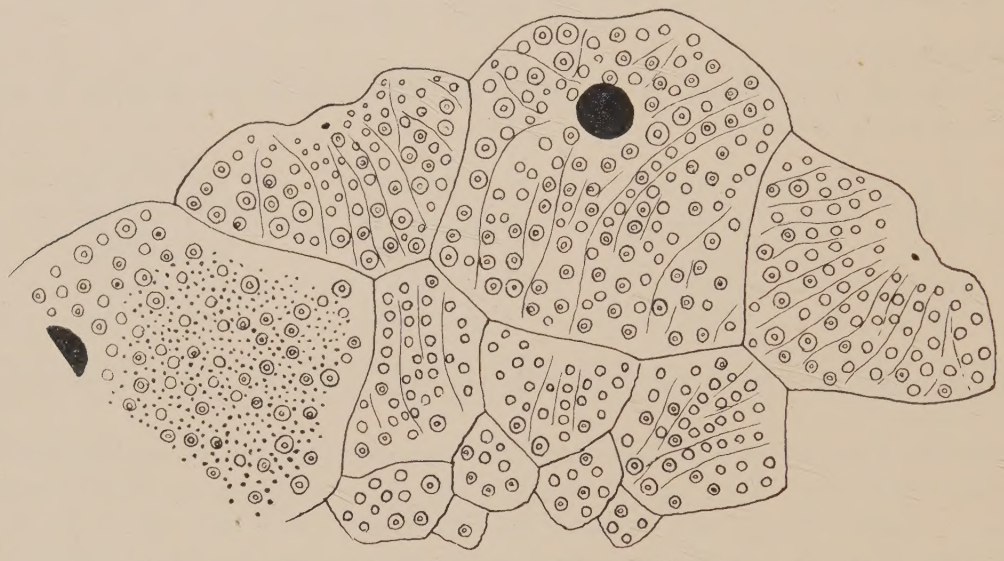
*Ambulacra* rather broad, about one-third the width of the interambulacra or even more than one-third. They are only slightly sinuate, and less so adapically than on the oral half. Interporiferous zone rather unusually broad, about twice the width of a pore-zone. Marginal series of tubercles very regular ; the tubercles are small, but contiguous. Adradially to the marginal tubercle each plate carries 3–4 not much smaller tubercles, forming more or less regular horizontal series. The whole interporiferous zone closely covered by these secondary tubercles, there being no naked median line, whereas the sutures between the plates are fairly distinct. The pore-zones scarcely sunken ; the pores are of medium size, rather distant, the wall being broad, but nearly flat ; the ridge is very inconspicuous (Pl. V, fig. 1).

*Interambulacra.*—The areoles are rather large and deep, well separated even to the peristome. The two uppermost plates in one or both series with much reduced primary tubercles, or the tubercle totally lacking on the uppermost plate. As these upper plates are very high, this results in the whole upper side being devoid of primary spines. The primary tubercles do not show any trace of crenulation. The scrobicular edge not thickened ; the scrobicular tubercles are fairly large, but as they are placed on the very edge of the areole, reaching half way down the sides, they are rather inconspicuous. Outside the scrobicular circle the plates are covered, on all sides the areole, by a fine, very close and uniform tuberculation, leaving no naked, or sunken, median line. A number of sharp, sunken lines passing from areole to areole, across the median area or between the areoles of the same series, produce a more or less conspicuous arrangement of the

secondary tubercles, in horizontal or vertical lines, or in arches. A varying number of impressions from the large globiferous pedicellariæ are found along the sutures, and also partly on the plates themselves. The median area is broad, at the ambitus equalling the width of the areoles.

*Apical system.*—The ocular plates all rather broadly insert. Madreporite not enlarged. The whole apical system closely covered by a uniform, fine tuberculation, partly rather distinctly arranged in radiating lines separated by sharp furrows like those of the interambulacra (Text-fig. 3). *Peristome* about the same size as the apical system. There are *c.* 15 ambulacral plates in a series, the pores forming a regular straight line. The interradii are rather unusually broad, the plates being partly arranged in double series ; there are 10–12 interradial plates, reaching almost to the edge of the mouth.

*Primary spines* slender, cylindrical, or tapering to a point. There may be a fairly distinct terminal crown on some of the ambital spines ; it is oblique, the adapical side of



TEXT-FIG. 3.—Part of apical system of *Stereocidaris reducta*. × 5.

it being the larger. Some of the older spines in one of the specimens look obliquely worn at the tip, as if they had served for walking on them. The shaft of the primary spines is provided with about 15 low, smooth, or very finely serrate ridges, the space between these ridges being filled up by a coat of anastomosing hairs. The surface of the spines, when well preserved, is accordingly rather smooth. There is a short shining neck, not much longer than the collar, which is *c.* 1·5 mm. long, increasing very markedly in thickness towards the inconspicuous milled ring. The oral primaries are all somewhat trumpet-shaped widened at the point, and distinctly longitudinally ridged. The primary spines are, on the whole, remarkably brittle, only few being preserved unbroken.

*Secondary spines.*—The scrobicular spines are *c.* 4 mm. long, closely appressed. They are almost rectangular, excavated along the midline on their outer side. The marginal ambulacral spines *c.* 3 mm. long, flat, closely appressed. The secondary spines very small, squamiform, closely appressed, with a more or less conspicuous glandular ampulla. The passage from the scrobicular and marginal ambulacral spines to the small secondary spines is very abrupt.

*Pedicellariæ.*—The large globiferous pedicellariæ rather numerous, placed mainly

along the horizontal sutures in the interambulacra, but also on the plates themselves; also in the ambulacra they may occur, as well as on the apical system. The valves of the typical *Stereocidaris* shape; the stalk quite short (Pl. VI, fig. 15). Small globiferous pedicellariæ without end-tooth, as typical (Pl. VI, fig. 14). Tridentate pedicellariæ well developed, head *c.* 1 mm. long; the valves rather slender, joining in nearly their whole length (Pl. VI, fig. 16). *Spicules* of tube-feet slender, rather smooth rods. The gonads and intestinal wall apparently totally devoid of spicules.

*Colour.*—The general colour is a light brownish. The primary spines, when fresh, light pinkish. The scrobicular spines a dark olive, with the edges lighter; the marginal ambulacral spines also dark olive, at least in their basal part. The denuded test is a rather conspicuous green, particularly on the apical system and the upper part of the interambulacra. At the ambitus it may pass into a reddish tint.

*Biology.*—Some specimens of a *Crepidula* were found attached to some of the primary spines; also hydroids and worm-tubes.

*Remarks.*—This species is related to *St. microtuberculata* (Yoshiwara) and *excavata* Mrtsn., as also to *St. tubifera* Mrtsn., but differs conspicuously from them all in the greater reduction of the primary tubercles on the aboral side. In this regard it is, together with *St. japonica* Döderlein, the most specialized of all recent *Stereocidaris* species.

*Cidaris mabahissæ* n. sp. (Pl. I, figs. 5, 6; Pl. IV, fig. 4; Pl. V, fig. 5; Pl. VI, figs. 3, 5, 8, 12, 13.)

Occurrence:

St. 140, 26.iii.1934, 2° 40′ S., 73° 22′ E., 515–525 m., off the Maldive Islands. 1 specimen.

Descriptive Notes:

| H.d. mm. | V.d. mm. | Apical system. | Peristome. | Number of I.A. | Number of A. pro I.A. | Longest spines. |
|---|---|---|---|---|---|---|
| 37 | 25 | 17 mm. (46% h.d.) | 13 mm. (35% h.d.) | 7 (8) | 13–14 | 56 mm.+? |

*Test* conspicuously flattened on the aboral side, less so on the oral side. Sides subvertical, slightly narrowing towards the oral side, the largest width of the test being at the upper ambital part. Circumference round.

*Ambulacra* scarcely one-third the width of the interambulacra, rather conspicuously sinuate. Interporiferous zone somewhat broader than the pore-zone. Marginal tubercles very nearly contiguous, forming quite regular series. Adradially to the marginal tubercle each plate carries one or two secondary tubercles, which form a fairly conspicuous series adradially to the marginal series. Also some scattered miliary tubercles are found, there being no naked median line. The pores are unusually broad, separated by a very narrow, elevated wall (Pl. V, fig. 5). The ridge is narrow, not very sharp.

*Interambulacra.*—The areoles of moderate size, fairly deep, well separated, at most the two adoral ones confluent. No trace of crenulation observable. The scrobicular circle not elevated, the tubercles not very conspicuous. Outside the scrobicular circle the plates densely covered with secondary tubercles, which decrease gradually in size towards the slightly sunken median line. The median space is narrow, scarcely half the width of the areoles. The sutures are sharp and well marked, but there is no naked median line. The space to the adradial side of the areoles is narrow, giving room only for very few

secondary tubercles. There are some, not very conspicuous, horizontal lines across the median space, not distinct enough for producing an arrangement in horizontal lines of the secondary tubercles.

*Apical system.*—The oculars very nearly insert, except ocular IV. Madreporite not enlarged, the pores being confined to a rather small patch in the middle of the plate. The whole apical system somewhat sparsely covered with secondary tubercles, those along the inner edge of the genital plates elongate, comma-shaped; but between the secondary tubercles there are numerous miliary, pedicellariæ-bearing tubercles, the plates being thus wholly covered, with exception of a rather narrow inner border (Text-fig. 4). *Peristome* distinctly smaller than the apical system, very nearly flat. There are 10–11 ambulacral plates in a series, the pores arranged in regular, single series. Inter-

Text-fig. 4.—Part of apical system of *Cidaris mabahissæ*. × 5.

radial plates 3–4 in each series, not reaching the mouth-edge. Edge of the peristome not sunken.

*Primary spines.*—None of the larger primary spines preserved in full length; they must be about twice the horizontal diameter. They are very slender, cylindrical, scarcely at all tapering. In one of the upper primaries, preserved full length, there is the merest indication of a terminal crown. The shaft is provided with 10–12 finely serrate, not very prominent, longitudinal ridges, the space between which is filled up by a coat of anastomosing hairs. There is a fairly conspicuous, shining neck, *c.* 2 mm. long. The collar is about 1 mm. long, gradually increasing in thickness towards the inconspicuous milled ring. The oral primaries slender, smooth, or with fairly distinct lateral serrations; the 3rd and 4th transitional to the ambital spines. *Secondary spines* not strongly appressed. The scrobicular spines are *c.* 4 mm. long, smooth, somewhat excavated on the outer side, terminating in a rounded point. The marginal ambulacral spines *c.* 3 mm. long, more slender, almost setaceous. Miliary spines likewise setaceous, without glandular ampulla.

*Pedicellariæ.*—The large globiferous pedicellariæ, which occur in fair numbers, have unusually slender valves, which join only with their terminal part (Pl. VI, figs. 3, 5) ; but the large opening and conspicuous end-tooth are distinctly of the type characteristic of the *Cidarina*. The stalk is rather long and slender, without trace of a limb. The small globiferous form not peculiar, the end-tooth distinct in the smaller samples (Pl. VI, fig. 13), less distinct in the larger, more elongate ones, which form a transition to the tridentate type (Pl. VI, fig. 12). This latter reaches a size of *c.* 2 mm. length of head ; the valves are narrow, slender, not peculiar ; they join in nearly their whole length (Pl. VI, fig. 8). *Spicules* of the tube-feet slender, mostly nearly smooth rods.

*Colour.*—Primary spines whitish, only the neck with a slight tint of pink. Usually a narrow dark ring on the border between the neck and the collar, which latter is somewhat darker than the neck, more brownish. The secondary spines a light brownish, with a darker median line on the scrobicular spines. The denuded test has a tinge of green on the apical system and the upper primary tubercles ; otherwise it is whitish, the ambulacra being slightly darker, with a tinge of olive in the interporiferous zone.

*Biology.*—A couple of the primary spines carry some quite large colonies of Hydroids ; otherwise they are rather clean, but a few small *Crepidula* and Scalpellids are found attached to them.

*Remarks.*—In its general appearance this species is very like the Atlantic *Cidaris cidaris*. But it differs markedly from that species, as also from the other known species of the genus *Cidaris* in the much larger size of the pores. It might be questionable whether this character would not justify regarding *mabahissæ* as the type of a separate genus. I think it preferable, however, to leave it in the genus *Cidaris*, thereby emphasizing the important zoogeographical fact that we have here a representative (or at least a very close relative) in the Indian Ocean of the genus *Cidaris*, which is otherwise confined to the Atlantic Ocean (including the West Indian region).

The present species, together with the next described *Lissocidaris fusca*, are the first representatives of the group *Cidarina* found outside the Atlantic, all previous records of the occurrence of "*Dorocidaris papillata*", or of the genus "*Dorocidaris*", in the Red Sea, the Indian Ocean, the Malay Seas, etc., being erroneous, as I have shown in my Monograph of the Echinoidea, I (pp. 299, 371, etc.).

### *Lissocidaris* n. g.

Pores not conjugate, the wall almost flat. Pores on peristome in single regular series. Primary tubercles perforate, the ambital ones with a trace of crenulation. Madreporite not enlarged. Primary spines long and slender, finely longitudinally striated, but perfectly smooth, the hairs coalescing at the surface so as to form a perfectly dense, smooth layer. Secondary spines not strongly appressed. The large globiferous pedicellariæ with a distinct end-tooth ; stalk very short. Small globiferous pedicellariæ with a small but distinct end-tooth.

Genotype : *Lissocidaris fusca* n. sp.

The character of the large globiferous pedicellariæ shows this genus to belong to the group of the *Cidarina*. Among the genera of this group it recalls by its smooth primary spines *Calocidaris* ; but this smoothness of the spines in the two genera is of totally different morphological value : in *Calocidaris* it is due to the total absence of hairs, the cortex layer

itself being smooth and shining on its surface; in the present genus the cortex layer is covered by a thick layer of anastomosing hairs, which coalesce so as to form a perfectly smooth surface. There is thus no question but that the present form represents a distinct genus, the more interesting as the group of the *Cidarina* was not hitherto known to be represented outside the Atlantic. Another representative of the same group, likewise from the Indian Ocean, is the species described above under the name of *Cidaris mabahissæ* n. sp.

*Lissocidaris fusca* n. sp. (Pl. III, figs. 1–3; Pl. V, fig. 2; Pl. VI, figs. 1, 2, 6, 19.)

Occurrence:

St. 157, 6.iv.1934, 4° 44′ N., 72° 55′ E., 229 m., off the Maldive Islands. 1 specimen.

Descriptive Notes:

| H.d. mm. | V.d. mm. | Apical system. | Peristome. | Number of I.A. | Number of A. pro I.A. | Longest spines. |
|---|---|---|---|---|---|---|
| 50 | 34 | 20 mm. (40% h.d.) | 20 mm. (40% h.d.) | 8 | 14–16 | 64 mm. |

*Test* almost regularly spherical, only flattened above, and somewhat less so on the oral side.

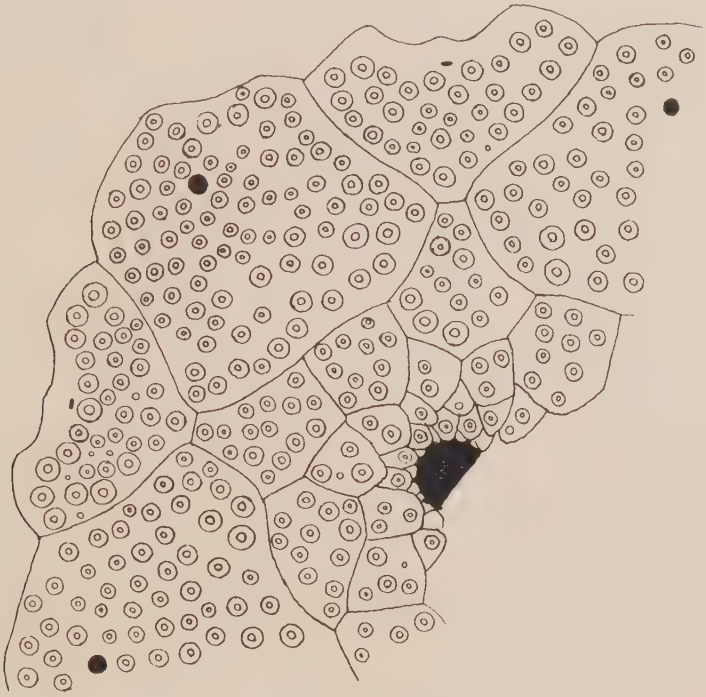
*Ambulacra* scarcely one-third the width of the interambulacra, slightly sinuate; interporiferous zone about twice the width of a pore-zone. Marginal series of tubercles perfectly regular; the tubercles fairly large, contiguous. Adradially to the marginal tubercle each plate carries two or three secondary tubercles, the outer one the larger, and forming a fairly regular series inside the marginal series. There is no naked or sunken median line. The pore-zones only slightly sunken. The pores are separated by a fairly broad, low wall; the ridge is narrow, not high (Pl. V, fig. 2). A very unusual feature is the existence in a few places of a distinct tubercle (spine) on the middle of the ridge.

*Interambulacra.*—The areoles are rather small, distinctly separate, even the two lowermost ones scarcely confluent; those below the ambitus distinctly transverse oval. They are not very deep, the scrobicular edge not elevated or thickened. The 2–3 ambital primary tubercles show traces of crenulation on the adapical side. The scrobicular tubercles of moderate size. Outside the scrobicular circle the plates rather densely covered with secondary tubercles, which decrease gradually in size towards the slightly sunken, but not naked, median line. Also on the outer side of the areoles there is a rather broad space covered with secondary tubercles continuing even to the peristomial edge, a very unusual case in Cidarids. The median area is a little more than half the width of the areoles. On the uppermost interambulacral plates there are some rather deep horizontal lines, continuing across the areoles. This produces the aspect of the secondary tubercles being arranged in horizontal series. On the other plates there is no such linear arrangement.

*Apical System.*—The ocular plates all narrowly insert. The whole apical system covered uniformly by small tubercles (Text-fig. 5). The *peristome* of the same size as the apical system (40% h.d.). There are 10–11 ambulacral plates in a series, the pores in a single, regular line; 5–6 interradial plates in a fairly regular series, reaching almost to the mouth-edge. Peristomial edge slightly sunken.

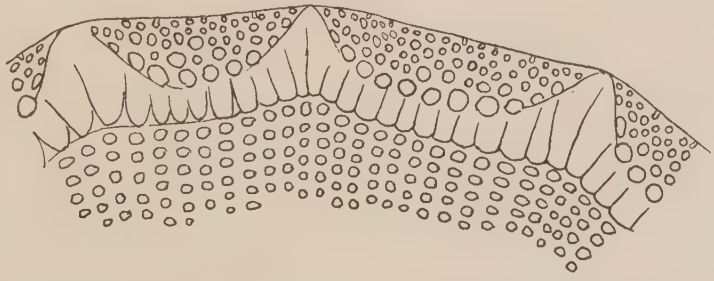
The *primary spines* are slender, almost cylindrical, or slightly flattened, at most tapering very slightly; the tip is not widened. The surface is very smooth, though not

shining. On a closer inspection one sees a number (*c.* 20–35) of fine, smooth, longitudinal lines, not raised above the general surface; in the distal part of the spine these lines become more pronounced ridges, but they remain smooth. On sections of the spines it is seen that these lines are in reality rather high ridges, but the space between them is



Text-fig. 5.—Part of apical system of *Lissocidaris fusca*. × 5.

entirely filled up by a dense mass of anastomosing " hairs ", which form a perfectly smooth outer surface, perforated only by microscopical holes (Text-fig. 6). There is a rather long, shining neck, *c.* 3 mm. long, twice the length of the collar, which latter increases markedly in thickness towards the very inconspicuous milled ring. The oral primaries



Text-fig. 6.—Part of transverse section of a primary spine of *Lissocidaris fusca*. × 85.

are rather broad, flattened, almost the shape of a cricket-bat, but slightly curved towards the end; their sides are smooth, but their surface distinctly longitudinally striped, particularly on the outer (adapical) side. The 3rd and 4th are transitional to the ambital spines.

The *secondary spines* are not strongly appressed. The scrobicular spines are *c.* 5–6 mm. long, slender, not much flattened, terminating in a rounded point. The marginal

ambulacral spines only slightly shorter, but more slender, almost setaceous. The miliary spines likewise setaceous, erect, without any glandular ampulla.

*Pedicellariæ.*—The large globiferous form is very short-stalked ; the valves have a very distinct end-tooth (Pl. VI, fig. 2). Two-valved samples are not rare (Pl. VI, fig. 19). The small globiferous pedicellariæ have slender valves, with a small but distinct end-tooth (Pl. VI, fig. 6). This form is remarkably scarce, a rather unique case among Cidarids, this form being generally very common, in contradistinction to the large globiferous form which is in many species of exceedingly rare occurrence or even apparently totally lacking. The tridentate pedicellariæ have rather coarse valves, which join only in the distal half ; there are some more or less developed irregular crests in the blade (Pl. VI, fig. 1). The *spicules* of the tube-feet are nearly smooth rods.

*Colour.*—The primary spines are a creamy-white, sometimes with a narrow dark ring ; the neck is a light pink, the collar darker, more brownish-red. The secondary spines, as well as the skin of the test, a uniform dark red-brown. The denuded test of the same red-brown colour on the apical system and the uppermost interambulacral plates ; the ambulacra of somewhat lighter colour, about straw-colour.

*Biology.*—Among the primaries is found a Polynoid worm ; on the larger primaries a number of *Crepidula* are attached, as also some tubes of Serpulids.

*Remarks.*—The character of the primary spines recalls the genera *Centrocidaris*, *Schizocidaris* and *Kionocidaris*, particularly the first-named. The structure of the large globiferous pedicellariæ show, however, that there is no near relationship between these genera. This peculiar spine-structure must evidently have developed separately along four different lines, and the very similar end-result represents a marked case of convergency.

The two-valved large globiferous pedicellariæ, not known elsewhere in Cidarids, may perhaps be a normal feature in this species ; if so that may be another generic character. From the single specimen at hand this, of course, cannot be decided.

### *Stylocidaris bracteata* var. *mauritiana* Mrtsn.

*Stylocidaris bracteata* var. *mauritiana* Mortensen, 1932, New Contrib. Knowl. Cidarids, p. 161, pls. vii, viii, ix, figs. 10–12, and pl. xii, figs. 3–5, 7.

Occurrence :

St. 24, 9.x.1933, 11° 54′ N., 51° 13′ E., 73–200 m., off Cape Gardafui. 4 specimens.

Descriptive Notes.—These specimens agree very closely with the form from Mauritius described under the above name in my paper of 1932. It should only be pointed out that the brown spots at the horizontal interambulacral sutures are found in the present specimens only at the median end of the sutures, not at the adradial end.

Large globiferous pedicellariæ are not found in the present specimens, as was the case also in the Mauritius specimens. Neither was found the peculiar sort of short-stalked tridentate pedicellariæ, which was found in the Mauritius specimens (*op. cit.*, pl. xii, fig. 4).

This form bears much resemblance to *Stylocidaris albidens* H. L. Clark, and might perhaps equally well be regarded as a variety of that species as of *bracteata*. The matter is comparatively unimportant, the main thing being that it must be kept as a separate variety at least, and cannot simply be referred to either of the two species, *bracteata* or *albidens*.

*Stylocidaris lævispina* n. sp. (Pl. II, fig. 5 ; Pl. IV, figs. 1, 5 ; Pl. V, fig. 6 ; Pl. VI, figs. 7, 10, 11.)

Occurrence :

St. 24, 9.x.1933, 11° 54′ N., 51° 13′ E., 73–200 m., off Cape Gardafui. 5 specimens.

Descriptive Notes :

| H.d. mm. | V.d. mm. | Apical system. | Peristome. | Number of I.A. | Number of A. pro I.A. | Longest spines. |
|---|---|---|---|---|---|---|
| 37 | 26·5 | 16 mm. (43% h.d.) | 15 mm. (40·5% h.d.) | 7 | 11–12 | 40 mm. |
| 35 | 23 | 16 ,, (46% ,, ) | 15 ,, (43 % ,, ) | 6 | 13–14 | 43 ,, |
| 35 | 22 | 15 ,, (43% ,, ) | 12 ,, (34 % ,, ) | 6–7 | 13–14 | 42 ,, |
| 30 | 19 | 14 ,, (47% ,, ) | 12·5 ,, (41 % ,, ) | 6 | 13–15 | 47 ,, |
| 25 | 15·5 | 12 ,, (48% ,, ) | 11 ,, (44 % ,, ) | 6 | 11–12 | 57 ,, |

*Shape of test* low, rounded, more or less flattened on both oral and aboral side, there being, as appears from the measurements, a rather considerable variation in the height. The sides are beautifully arched, the circumference round.

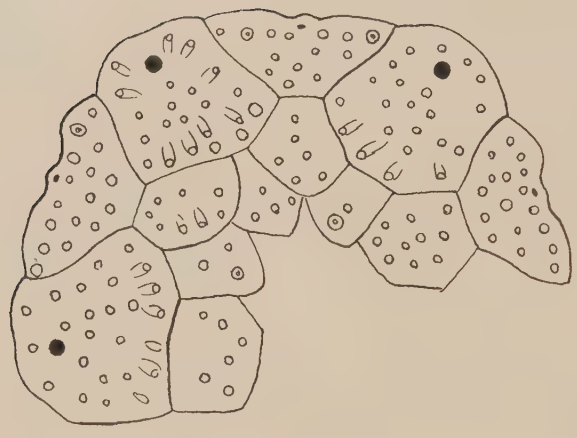
*Ambulacra* one-third the width of the interambulacra, slightly sinuate, the interporiferous zone only about as broad as a pore-zone. Marginal series of tubercles perfectly regular, the tubercles rather small, not contiguous, separated by a series of small miliary (pedicellariæ-bearing) tubercles. Adradially to the marginal tubercle each plate carries one single secondary tubercle placed at the lower edge of the plate, forming a regular series parallel to the marginal series. The median part of the interporiferous zone naked, but not sunken. The pores are rather large, the wall broad, rising at its upper side into a rather sharp edge, higher than the ridge, which is very inconspicuous (Pl. V, fig. 6).

*Interambulacra.*—Areoles of medium size, not deepened, well separated, except the two lowermost ones, which are confluent. The uppermost, not quite fully formed, areole in one or both series slightly prolonged upwards (effluent). No trace of crenulation on the primary tubercles. The scrobicular tubercles small, and rather widely separated, scarcely larger than the secondary tubercles, which cover the rest of the plate, leaving no naked median line. The median space narrow, only half the width of the areoles.

*Apical system* varying rather considerably in size, 43–48% of the horizontal diameter. The oculars all insert, more or less broadly (Text-fig. 7 *a*, *b*). Madreporite not enlarged. The apical plates on the whole rather sparingly tuberculated ; the tubercles along the inner edge of the genital plates may be very conspicuously comma-shaped. *Peristome* somewhat smaller than the apical system. There are *c.* 12–13 ambulacral plates in a series, the pores forming a single, straight line. Interradial plates usually 6, in a regular series reaching almost to the mouth edge.

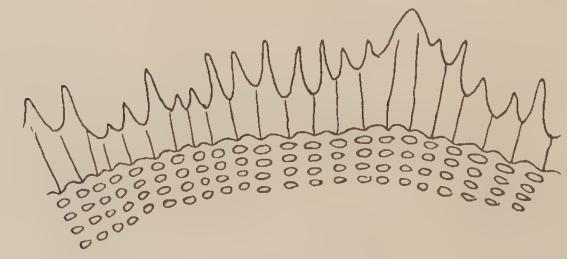
*Primary spines* from about as long as the horizontal diameter of the test to more than twice that length. They may be slightly fusiform or simply cylindrical, tapering gently to a point. The surface of the shaft is smooth, but with *c.* 15 low, non-serrate, or at most very indistinctly serrate ridges. The space between the ridges very finely striated, without hairs, only with some low, simple prominences (Text-fig. 8). There is a smooth neck of *c* 3 mm. ; the collar is *c.* 1·5 mm., increasing slightly in thickness towards the fairly conspicuous milled ring. The oral primaries are finely ridged on the aboral side, with smooth edges, only slightly widened ; the third is transitional to the ambital spines. *Secondary spines* : The scrobicular spines are *c.* 4 mm. long, not much appressed, they are

*a*



*b*

Text-fig. 7*a*, *b*.—Parts of apical system of *Stylocidaris lævispina*. × 6. Showing variation in the insert condition of the ocular plates.



Text-fig. 8.—Part of transverse section of primary spine of *Stylocidaris lævispina*. × 85.

almost rectangular, somewhat excavated on the outer side. The ambulacral spines more slender, *c.* 3 mm. long. The smaller secondaries erect, pointed, without a glandular ampulla.

*Pedicellariæ.*—The large globiferous form not observed in any of the specimens. In compensation the small globiferous form is very richly developed, both in numbers and size, some of them, mainly found between the scrobicular spines, reaching a size of 1 mm. length of head. Sometimes the valves are irregular, recalling the curious irregular pedicellariæ found in some species of *Stylocidaris* (*cf.* Monograph Ech. I, p. 361) (Pl. VI, figs. 7, 11). The tridentate pedicellariæ are also very well developed, reaching a size of *c.* 2 mm. length of head. The valves are very slender, joining only at the point (Pl. VI, fig. 10). *Spicules* of the tube-feet and the intestinal wall as usual in *Stylocidaris.*

*Colour.*—The test with the spines on it is cream-coloured, with the apical system dark brownish, this brownish colour continuing along the ambulacral midline and the midline and horizontal sutures of the interambulacra. The denuded test is white, with a green tinge on the upper interambulacral plates and the interporiferous zone of the ambulacra. Also the ocular plates are whitish, with a green tinge, whereas the genital plates are a dark olive, forming thus a very conspicuous star. Also the periproct is dark olive. The primary spines are light pinkish, with a more or less distinct narrow, dark ring at the limit between collar and shaft. The secondary spines are nearly white, only with an indication of a darker midline.

*Biology.*—This species is unusual in that its spines are very little infested with foreign organisms ; only some small specimens of a sort of *Vermetus*, a few Serpulid tubes and Foraminifera (*Polytrema*) may be found here and there, the spines in general remaining clean.

*Remarks.*—This species is evidently very closely related to *Stylocidaris tiara*, but differs markedly from it in the character of the primary spines, which in *St. tiara* have only 8 longitudinal ridges, much stronger developed than in the present species, with 15–16 longitudinal ridges. Also the spines are much more slender and fragile in *tiara* than in the present species. Though not of very great importance this difference forbids identifying the present specimens with *tiara* and necessitates making a separate species of them.

### *Acanthocidaris curvatispinis* (Bell). (Pl. V, fig. 3.)

*Acanthocidaris curvatispinis* Mortensen, 1928, Monogr. Ech. I, p. 323, pl. lxxxiii, figs. 16–18 ; 1932, New Contrib. Knowl. Cidarids, p. 156, pl. v, figs. 1–5, pl. xi, fig. 4, and pl. xii, fig. 8.

Occurrence :

St. 24, 9.x.1933, 11° 54′ N., 51° 13′ E., 73–200 m., off Cape Gardafui. 1 specimen.

Descriptive Notes.—This specimen is in a very fragmentary condition, completely crushed ; it must have been some 35–40 mm. h.d., thus about half grown. It is rather dark coloured, the secondary spines a brownish-olive. The same colour is found on the denuded test in the ambulacra, in the interporiferous area, whereas the interambulacra are rather dark-greenish. The collar of the primary spines is of an olive colour, with the characteristic series of whitish elevations accompanied by small purple spots.

No large globiferous pedicellariæ found.

The pores differ rather conspicuously from those of the young specimens, as

represented in my paper of 1932, pl. xi, fig. 4, the outer pore being distinctly larger (Pl. V, fig. 3).

Our knowledge of this splendid Cidarid is still unsatisfactory, no adult specimen being as yet available for study. Recently a very fine adult specimen has been taken on a fishing line at Mauritius, off Black River, at a depth of *c.* 200 metres, as I am informed by my friends, Mr. G. Antelme and Major L. Regnard, Port Louis. This, the third adult specimen known, is now in the Museum of Port Louis, Mauritius, being one of the fine treasures of that museum.

*Prionocidaris baculosa* (Lamarck). Forma typica.

*Prionocidaris baculosa* Mortensen, 1928, Monogr. Ech. I, p. 439, pl. xlvii, figs. 2, 3, pl. xlviii, fig. 2, etc.

Occurrence :

St. 45, 29.x.1933, 18° 3′ N., 57° 02′ E., 38 m. 4 specimens.

St. 71, 26.xi.1933, 25° 35′ N., 56° 42′ E., 106 m., Gulf of Oman, Hormuz Strait. 2 specimens.

*Prionocidaris pistillaris* (Lamarck).

*Prionocidaris pistillaris* Mortensen, 1928, Monogr. Ech. I, p. 452, pls. xlix, l and li, etc.

Occurrence :

St. 24, 9.x.1933, 11° 54′ N., 51° 13′ E., 73–200 m., off Cape Gardafui. 5 specimens.

Descriptive Notes.—These specimens, ranging in size from 32 to 13·5 mm. h.d., are perfectly typical examples of this species, as described in my Monograph. (*loc. cit.*).

Text-fig. 9.—Parasitic gastropod (? *Mucronalia*) from *Prionocidaris pistillaris*. × 15. (H. Fasmer del.)

It may be mentioned that the primary spines of the youngest specimen are fairly distinctly banded with darker and lighter brownish in the distal part. One of the larger specimens, which I have partly denuded, shows scarcely any trace of greenish tint on the aboral side, as otherwise characteristic of the species. In the two smallest specimens tridentate pedicellariæ are well developed; they are very much like those of *Pr. baculosa*.

Genital pores are only beginning to appear in a specimen of 17 mm. h.d.

This species is still known only from the western part of the Indian Ocean and would seem to be characteristic of that area.

I may take the opportunity of mentioning here that a specimen of this species from the coral reef at Inhaca, Delagao Bay (sent me by Prof. C. J. v. d. Horst, Johannesburg) is infested by some specimens of a parasitic Gastropod, which lives in galls in the test. The galls are on the inside, opening to the outside only through a small pore. As seen from Text-fig. 9, representing an adult specimen (it was found dead within the gall), it is a fairly large form of the genus *Stylifer* or *Mucronalia*, characterised by the great width of the test ; evidently it is a new species.

The galls are all of them in the ambulacra. As suggested by Koehler in his description of another parasitic snail, a *Mucronalia*, living on *Stereocidaris indica*, it appears that the parasite enters through the ambulacral pores, thus avoiding the trouble of making for itself the necessary perforation of the test (*cf.* Koehler, " Investigator " Echinoidea, III, p. 137 ; " Anomalies, Irregularités et Deformations du Test chez les Echinides ", 'Ann. Inst. Océanogr.', I, 1924 ; Appendix, p. 441).

## Family Echinothuridæ.

### *Phormosoma bursarium* A. Aggassiz.

*Phormosoma bursarium* A. Agassiz, 1881, " Challenger " Ech., p. 99, pl. x, fig. b.
*Phormosoma indicum* Döderlein, 1906, Ech. d. deutschen Tiefsee-Exp., p. 130, taf. xv, figs. 1, 2, taf. xxxviii, figs. 2, 3.
*Phormosoma bursarium* Mortensen, 1935, Monogr. Ech. II, p. 135, pl. ii, fig. 20, pl. iii, figs. 1, 2 and pl. lxxiv, figs. 11–15.

Occurrence :

St. 107, 12.i.1934, 5° 15′ S., 39° 33′ E., 421–457 m., Pemba Strait. 1 specimen, large, fine.
St. 108, 13.i.1934, 5° 18′ S., 39° 24′ E., 786 m., Pemba Strait. 19 specimens, in poor condition.
St. 109, 13.i.1934, 5° 11′ S., 39° 34′ E., 640 m., Pemba Strait. 4 young specimens.
St. 110, 14.i.1934, 5° 04′ S., 39° 15′ E., 329 m., Pemba Strait. 13 specimens, most of them in very poor condition.
St. 115, 15.i.1934, 5° 05′ S., 39° 22′ E., 640–658 m., Pemba Strait. 4 specimens.
St. 122, 22.i.1934, 5° 21′ S., 39° 23′ E., 732 m., Pemba Strait. Numerous specimens, mostly in very poor condition.
St. 145, 31.iii.1934, 4° 59′ S., 73° 16′ E., 494 m., off Maldive Islands. 4 specimens in poor condition.
St. 184, 4.v.1934, 14° 36′ N., 51° 00′ E., 1270 m., Gulf of Aden. 2 specimens.

Descriptive Notes.—These specimens belong to the form described by Döderlein, *op. cit.*, as *Phormosoma indicum*, which, in my opinion (Monograph, *loc. cit.*), represents the typical *Ph. bursarium*. They are nearly all in a very poor state of preservation and do not give occasion for further remarks beyond what is stated in my Monograph. It should be stated that the tridentate perdicellariæ appear to be all of the slender form.

### *Phormosoma verticillatum* Mrtsn. (Pl. VI, fig. 4.)

*Phormosoma verticillatum* Mortensen, 1904, Echinothurids from Japan and the Ind. Ocean, Ann. Mag. Nat. Hist. (7 ser.), XIV, p. 90, pl. iv, figs. 1, 2, pl. v, figs. 15–17.

*Phormosoma adenicum* Döderlein, 1906, Ech. d. deutschen Tiefsee-Exp., p. 134, taf. xv, fig. 3, taf. xxxviii, fig. 4.

*Phormosoma verticillatum* Mortensen, 1935, Monogr. Ech. II, p. 142, pl. iii, figs. 3, 4, pl. iv, fig. 4, pl. lxxiv, figs. 7–10.

Occurrence :

St. 158, 7.iv.1934, 4° 42′ N., 72° 42′ E., 786–1170 m., off Maldive Islands. 1 young specimen, 13 mm. h.d. Identification uncertain.

St. 184, 4.v.1934, 14° 36′ N., 51° 00′ E., 1270 m., Gulf of Aden. 3 specimens.

Descriptive Notes.—One of the specimens is 81 mm. in diameter, thus being considerably larger than any specimen hitherto recorded, and proves that this species may reach about the same size as *Ph. placenta* and *bursarium*, the two other common species of this genus. (Of the third species *Ph. rigidum* we still know only one specimen, the type.) Another specimen, 67 mm. h.d., has kept its shape very beautifully, showing that, as in *Ph. placenta*, the aboral side is low hemispherical, the oral side flat and the edge rather sharp ; the vertical diameter is *c.* 18 mm.

The colour is a dark brownish ; apparently it was darker on the oral side ; the large primary spines of the oral side particularly show traces of having been dark purplish.

The primary spines are all broken, but enough of them remains to show the characteristic whorls of thorns.

The large slender form of tridentate pedicellariæ (*vide* Monograph, II, p. 144, pl. lxxiv, fig. 9) was not found preserved in any of the specimens. The smaller, broad-valved form varies considerably in the shape of the valves, some being much broader than others ; they may also occur in a form with the valves distinctly inrolled in the basal part ; the apophysis is remarkably broad in this form (Pl. VI, fig. 4).

The young specimen from St. 158 is not referable with certainty to this species, though having much the appearance of it. None of the spines show the characteristic verticillation, but a couple of tridentate pedicellariæ seem to be of the long slender type characteristic of *Ph. verticillatum*.

### *Tromikosoma* (*?*) *uranus* (Wyv. Thomson). (Pl. V, fig. 8.)

*Hygrosoma uranus* Mortensen, 1927, Ech. du " Travailleur " et du " Talisman ", p. 25, pl. i, fig. 1, pl. ii, fig. 1.

*Tromikosoma uranus* Mortensen, 1935, Monogr. Ech. II, p. 168, pl. vi, figs. 2, 3, pl. lxxv, figs. 19–21.

Occurrence :

St. 133, 15.ii.1934, 1° 26′ S., 66° 34′ E., 3345 m., southern area of Arabian Sea. 2 young specimens, *c.* 40 and *c.* 50 mm. diameter.

Descriptive Notes.—These specimens agree with *Tr. uranus* in regard to the characters of the ambulacra and the pedicellariæ, and it would thus seem quite probable that they are really identical with the said species, in spite of the fact of its not being known hitherto from outside the Atlantic. It is, however, not safe to say definitely that they do belong to *Tr. uranus*, because of the insufficient knowledge we possess of that species, and also because the specimens from the Indian Ocean are only young ones. Also

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it seems that the spines are somewhat different, as seen on a comparison of the sections represented here (Text-fig. 10) with that of the typical *uranus* represented in fig. 101, p. 169 of my Monograph. If constant, this difference proves that the form from the Indian Ocean is not identical with the Atlantic *Tr. uranus*—but we do not know how constant and reliable this character is. The only thing that is certain is that the specimens from the Indian Ocean are very closely related to *Tr. uranus* ; whether identical or not cannot be decided from the material at present available.

In the smaller specimen one of the hoofed spines is preserved complete ; Pl. V, fig. 8 shows the shape of the hoof.

The genus *Tromikosoma* was not hitherto known from the Indian Ocean, so, even though the determination of the species is uncertain, the discovery that the genus does occur in the Indian Ocean is of considerable interest.

Text-fig. 10.—Part of transverse section of primary spines of *Tromikosoma (?) uranus* ; *a*, of an oral, *b*, of an aboral spine. × 200.

### *Hygrosoma hoplacantha* (Wyv. Thomson).

*Phormosoma hoplacantha* A. Agassiz, 1871, " Challenger " Ech., p. 101, pls. xi, xii, etc.
*Hygrosoma æthiopicum* Döderlein, 1906, Ech. d. deutschen Tiefsee-Exp., p. 141, taf. xvi, figs. 1–4, taf. xxxix, fig. 2.
*Hygrosoma hoplacantha* Mortensen, 1935, Monogr. Ech. II, p. 208, pl. xviii, fig. 1, pl. xix, fig. 1, pl. xx, figs. 1, 2, and pl. lxxviii, fig. 2.

Occurrence :

St. 33, 15.x.1933, 13° 41′ N., 48° 17′ E., 1295 m., Gulf of Aden. 5 specimens, in very poor condition.

St. 108, 13.i.1934, 5° 18′ S., 39° 24′ E., 786 m., Pemba Strait. Several young specimens.

St. 122, 22.i.1934, 5° 21′ S., 39° 23′ E., 732 m., Pemba Strait. 12 young and 3 large specimens, *c.* 200 mm. diameter, in very poor condition.

St. 124, 23.i.1934, 5° 39′ S., 39° 39′ E., 914 m., Pemba Strait. 1 specimen (fragments).

St. 143, 30.iii. 1934, 5° 19′ S., 73° 23′ E., 797 m., off Maldive Islands. 3 specimens, in very poor condition.

St. 184, 4.v.1934, 14° 36′ N., 51° 00′ E., 1270 m., Gulf of Aden. 2 specimens.

Descriptive Notes.—As pointed out in my Monograph (pp. 214, 215) there can be no doubt that Döderlein's *Hygrosoma æthiopicum* is identical with *H. hoplacantha*.

As for the specimen from New Amsterdam mentioned there, which Döderlein identified as *Hygrosoma hoplacantha*, the present material does not help us to settle the question of its identity with or distinctness from *hoplacantha*, because, unfortunately, all the larger specimens are in such a poor state of preservation as to be unfit for a more detailed study.

From each of Sts. 62 and 118 there are two small specimens of Echinothurids in such poor state of preservation that it is perfectly hopeless to try to identify them. Presumably they are all of them *Hygrosoma hoplacantha* ; but this cannot be more than a mere guess.

### *Sperosoma* sp.

Occurrence :

St. 118, 17.i.1934, 4° 06′ S., 41° 10′ E., 1798 m., off Mombasa. 2 young specimens, *c.* 15 and *c.* 25 mm. diameter.

Descriptive Notes.—Both these specimens are in very poor condition, with hardly a small piece of spine and not a pedicellaria left. Identification of the species would perhaps have been possible if the specimens were in perfect state of preservation ; as they are, identification as to species is out of the question. It can only be said that presumably they belong to one of the three species known from the Indian Ocean : *biseriatum* Döderlein, *durum* Döderlein, or *armatum* Koehler.

### *Arœosoma alternatum* Mrtsn.

*Arœosoma coriaceum* Döderlein, 1906, Ech. d. deutschen Tiefsee-Exp., p. 122, taf. xiv, fig. 1, taf. xxxviii, fig. 1. (*Non Arœosoma coriaceum* (A. Agassiz).)
*Arœosoma alternatum* Mortensen, 1935, Monogr. Ech. II, p. 270.

Occurrence :

St. 107, 12.i.1934, 5° 15′ S., 39° 33′ E., 421–457 m., Pemba Strait. 3 large specimens, *c.* 170 mm. diameter.

St. 110, 14.i.1934, 5° 04′ S., 39° 15′ E., 347–384 m., Pemba Strait. 1 large specimen.

St. 123, 22.i.1934, 5° 19′ S., 39° 32′ E., 255–366 m., Pemba Strait. 1 specimen.

These specimens are in perfect agreement with the description, given by Döderlein (*op. cit.*), under the erroneous name of *Arœosoma coriaceum*, of the single specimen taken by the " Valdivia " off the Somali coast.

To the remarks given in my Monograph (*loc. cit.*) I have only to add that in one of the specimens from St. 107 the outer series of interambulacral tubercles on the oral side is an alternating double series, there being here a tubercle on each plate, but so that on every other plate the tubercle is close to the adradial edge, on the alternating plates farther inwards.

Dactylous pedicellariæ have not been observed on any of the specimens ; this is, however, no proof of their non-existence in this species, since in four of the specimens in hand the aboral side is almost totally naked ; only in the specimen from St. 110 are the spines of the aboral side fairly well preserved, but, unfortunately, this specimen has been forced down into too small a jar, so that a thorough examination of it was made impossible.

*Asthenosoma varium* Grube.

*Asthenosoma varium* Mortensen, 1935, Monogr. Ech. II, p. 280, pls. lv–lviii, pl. lxi, figs. 1–6, and pl. lxii, figs. 1, 2, etc.

Occurrence :

St. 10, 17.ix.1933, 13° 31′ N., 42° 31′ E., 55 m., Southern part of Red Sea. 1 young specimen, 20 mm. diameter.

Descriptive Notes.—Although in poor condition this specimen can be identified with certainty as being a young *Asth. varium*, the few spines left being of the characteristic banded appearance.

The species having previously been found by Dr. Dolfuss in the Gulf of Suez (*cf.* Monograph, p. 287) there can be no doubt of its occurring all over the Red Sea at suitable depths.

Family Saleniidæ.

*Salenocidaris miliaris* var. *indica* n. var. (Pl. VI, fig. 9.)

Occurrence :

St. 155, 5.iv.1934, 4° 31′ N., 72° 38′ E., 2249 m., off Maldive Islands. 1 specimen.

St. 162, 10.iv.1934, 8° 08′ N., 72° 58′ E., 1829–2051 m., off Minikoi. 2 specimens.

Descriptive Notes.—This form belongs to the group *S. profundi* (Duncan)—*S. miliaris* (A. Agassiz), with which it agrees in Oc. I being broadly insert. It seems to me to stand nearer to *miliaris*, on account of its ambulacral pores being larger and its primary spines being more conspicuously verticillate than in *profundi* and more like those of *miliaris* ; but, on the other hand, it agrees more with *profundi* in the gradual passage from the adoral to the ambital interambulacral tubercles. In regard to the shape of the quadridentate pedicellariæ it differs from both of the said species (Pl. VI, fig. 9 to compare Monograph II, pl. lxxxvi, figs. 2 and 39). To identify these specimens directly with any of the two species I think unjustifiable, but as they are very closely related to them, I think it the right course to designate them as a variety of one of them.

A more detailed description seems unnecessary, the 4-dentate pedicellariæ being, as a matter of fact, the only noteworthy distinguishing character. I have not observed these pedicellariæ on the larger specimen from St. 162 (14 mm. h.d.), whereas they are well developed on the smaller one (8 mm. h.d.). In this latter specimen there are some tridentate pedicellariæ also on the buccal plates. Claviform pedicellariæ were not observed in any of the specimens.

On the specimen from St. 155 (which is badly crushed) a number of yellow egg-capsules are found attached all over the test ; it is evident that they are of some parasitic snail, which has probably been attached to some of the lacking parts of the test.

On the larger specimen from St. 162 the secondary spines are rather irregular and, particularly on the adapical part, somewhat thickened and more or less trumpet-shaped. It seems quite evident that this is something pathological, and this specimen therefore cannot be made the type of the variety ; in the two other specimens the secondary spines are normal, very much like those of *miliaris*.

One might rather have expected these specimens to be identical with the form described by Döderlein from the " Valdivia " collection as *S. hastigera*, also taken off the Maldive Islands ; this would seem the more probable, since the tridentate pedicellariæ are very much alike (*cf.* 'Ech. d. deutschen Tiefsee-Exped.', taf. xlv, fig. 3, d). But in Döderlein's specimen Oc. I is exsert, whereas in the present specimens, also in the smallest one, it is

broadly insert. Judging from what is known at present this is a character of primary importance in *Salenocidaris*, and thus the present specimens cannot be regarded as identical with the "Valdivia" specimen. Perhaps, when once a rich material of these forms becomes available, it will be found that the said character of Oc. I is not reliable, and if so, there can hardly be any doubt about the identity of the present specimens with the "Valdivia" specimen—but for the present we are not justified in regarding them as identical.

### Family Arbaciidæ.

### *Cœlopleurus Maillardi* (Michelin).

*Cœlopleurus Maillardi* Mortensen, 1935, Monogr. Ech. II, p. 627, pl. lxvii, fig. 3, pl. lxviii, fig. 4, and pl. lxix, figs. 1–3, etc.

Occurrence :

St. 24, 9.x.1933, 11° 57′ N., 51° 13′ E., 73–200 m., off Cape Gardafui. 1 young specimen.

Descriptive Notes.—This specimen, 13 mm. h.d., with genital pores not formed as yet, is perfectly typical. It may be mentioned that the genital plates have several irregular not distinctly radiating elevations in the proximal part, but no real tubercles; their appearance is thus rather different from that shown in fig. 369*c*, p. 632, of my Monograph. But this is clearly only a difference due to age, the specimen from which the said figure was drawn being 21 mm. h.d., thus nearly twice as big as the present specimen. A full-grown specimen of this species still remains a desideratum.

### Family Diadematidæ.

### *Diadema Savignyi* Michelin.

*Diadema Savignyi* Mortensen, 1904, "Siam" Ech., p. 16; A. Agassiz and H. L. Clark, 1908, Hawaiian Echini. Salenidæ . . . Diadematidæ, p. 114; H. L. Clark, 1925, Cat. Rec. Sea-Urchins Brit. Mus., p. 43.

Occurrence :

St. 27, 12.x.1933, 11° 57′ N., 50° 35′ E., 37–91 m., off Cape Gardafui. 2 young specimens.

Descriptive Notes.—The arrangement of the (faded) blue colour in a distinct ring on the apical system, and in two continuous lines down along the midline of the interambulacra seems to make the identification as *D. Savignyi* certain, in spite of the absence of the characteristic tridentate pedicellariæ.

### *Chætodiadema africanum* H. L. Clark.

*Chætodiadema africanum* H. L. Clark, 1924, Echinoderms S. African Fisheries and Mar. Biol. Survey, I, Sea-Urchins (Echinoidea), p. 2, pl. i; 1925, Cat. Rec. Sea-Urchins Brit. Mus., p. 49.

Occurrence :

St. 106, 12.i.1934, 5° 39′ S., 39° 16′ E., 183–194 m., Pemba Strait. 5 young specimens.

Descriptive Notes.—These specimens, ranging from *c.* 18 to 9 mm. horizontal diameter, are all in a poor state of preservation, more or less broken, with hardly a pedicellaria and only very few broken spines left. But they have the very characteristic design, a narrow, continuous reddish (in life probably bluish) line along each side of the naked interambulacral space on the aboral side; also a conspicuous spot on each genital

plate. The largest specimen has a faint pinkish, the others a faint greenish, tint, much as described by Clark (*op. cit.*, 1925). I have no doubt of the correctness of identifying these specimens as *Ch. africanum*.

The largest specimen is still without trace of the genital pores ; the youngest specimen has already all the oculars insert, though rather narrowly so.

### *Echinothrix calamaris* (Pallas).

*Echinothrix calamaris*, H. L. Clark, 1925, Cat. Rec. Sea-Urchins Brit. Mus., p. 44.

Occurrence :

St. 27, 12.x.1933, 11° 57′ N., 50° 35′ E., 37–91 m., off Cape Gardafui. 1 small specimen, in poor condition.

### *Centrostephanus nitidus* Koehler.

*Centrostephanus nitidus* Koehler, 1927, Echinoidea of the Indian Museum, III, p. 53, pl. ix, figs. 4–10, pl. x, figs. 1, 3, 4, 8, 9, and pl. xxvi, fig. 2.

Occurrence :

St. 157, 6.iv.1934, 4° 44′ N., 72° 55′ E., 229 m., off Maldive Islands. Several specimens.

Descriptive Notes.—These specimens are all of very nearly the same size, *c.* 35 mm. horizontal diameter. They conform very well with the careful description given by Koehler, and call for no further descriptive remarks at the present occasion (whereas a few additional notes will be given in Part III of my Monograph).

The fact that so many specimens of the same size were taken in one haul—and at no other station—and that Koehler's specimens were all from a single station—indicates that this species occurs in schools, as is the case with *Diadema*.

## Family Micropygidæ.

### *Micropyga violacea* de Meijere.

*Micropyga violacea* de Meijere, 1904, " Siboga " Ech., p. 63, taf. iv, figs. 29, 30, taf. xv, figs. 232–234.

Occurrence :

St. 109, 13.i.1934, 5° 11′ S., 39° 34′ E., 640 m., Pemba Strait. 3 specimens.

Descriptive Notes.—These specimens are fairly well preserved, particularly one of them, which shows a fair number of the club-shaped oral primary spines so characteristic of the genus *Micropyga*.

The species was not hitherto known from the Indian Ocean. The finding of it close to the African coast suggests that it may be distributed all over the tropical part of the Indian Ocean. The specimens differ from those of the Malayan region in the apical system being more sunken than I have seen in any Malayan specimen. If this proves to be a constant difference, there may be reason to distinguish the Indo-African specimens as a separate variety ; as there seems to be no other differences there can hardly be sufficient reason for distinguishing the East African specimens as a separate species.

### *Micropyga tuberculata* A. Agassiz.

*Micropyga tuberculata* A. Agassiz, 1881, " Challenger " Ech., p. 68, pl. vii ; Döderlein, 1906, Ech. d. deutschen Tiefsee-Exped., p. 169, taf. xxi, fig. 4, taf. xlii, figs. 1–6, taf. lxiii, figs. 1–8 and taf. lxiv, fig. 1.

Occurrence :

St. 123, 22.i.1934, 5° 19′ S.,39° 32′ E., 256–366 m., Pemba Strait. 1 specimen, in very poor condition.

Descriptive Notes.—The species was taken by the " Valdivia " in the Siberut Strait at Sumatra, being otherwise unknown from the Indian Ocean. The finding of it at the African east coast indicates that, like *M. violacea*, it must occur all over the Indian Ocean, in the tropical parts ; one can only wonder that the two species were not found by the " Investigator ".

## Family Aspidodiadematidæ.

### *Plesiodiadema amphigymnum* (de Meijere) (? Var.).

Occurrence :

St. 162, 10.iv.1934, 8° 08′ N., 72° 58′ E., 1829–2051 m., off Minikoi. 1 specimen.

Descriptive Notes.—The single specimen, 11 mm. horizontal diameter, is in poor condition, and does not allow a definite identification. It agrees with *Plesiodiadema amphigymnum* of the Malay Archipelago in the important character of the buccal plates carrying no spines, in the characters of the test and spines, as also in the presence of ophicephalous pedicellariæ without stalk-glands. But it differs conspicuously from the typical *amphigymnum* in the strong development of the periproctal plates, there being a circle of seven rather large plates round the anus and some small plates outside this circle, whereas the typical *amphigymnum* has the periproct almost naked. Unfortunately tridentate pedicellariæ are entirely lacking in the specimen of the Murray Expedition. As these pedicellariæ, both of the coarse and the slender type, afford important specific characters within the family of the Aspidodiadematids, their absence here deprives us of an important clue to settling the question whether this specimen represents only an individual, or a local variation of *Pl. amphigymnum*, or perhaps represents a closely related, but distinct species. Fresh material is needed for settling the question.

### *Plesiodiadema molle* (Döderlein).

*Dermatodiadema molle* Döderlein, 1906, Ech. d. deutschen Tiefsee-Exped., p. 160, taf. xx, figs. 4, 5, taf. xli, fig. 1.

Occurrence :

St. 133, 15.ii.1934, 1° 26′ S., 66° 35′ E., 3385 m., southern area of the Arabian Sea. 1 specimen.

The specimen is in exceedingly poor condition, much broken. There is, however, no doubt about its being identical with the specimens of *Pl. molle*, taken by the " Valdivia " between the Maldives and the Chagos Archipelago, thus in about the same area, and also at about the same depth (2919 m.).

## Family Temnopleuridæ.

### *Salmacis erythracis* H. L. Clark.

*Salmacis erythracis* H. L. Clark, 1912, Hawaiian Echini. Pedinidæ . . . Echinometridæ, p. 315, pl. cxi, figs. 4–6 ; 1925, Cat. of the Rec. Sea-Urchins Brit. Mus., p. 86.

Occurrence :

St. 27, 12.x.1933, 11° 57′ N., 50° 35′ E., 37–91 m. off Cape Gardafui. Several specimens, ranging in size from 38 to 27 mm. horizontal diameter.

The characteristic red colour of the secondary spines more or less developed, but there is no doubt that these specimens all belong to the species *erythracis*, characteristic of the western part of the Indian Ocean, not to *S. Dussumieri*, which is not known from this region.

*Temnopleurus Reevesii* (Gray).

*Temnopleurus Reynaudi* A. Agassiz, 1872, Revision of the Echini, p. 461, pl. viii, figs. 22–24, pl. viiia, figs. 6, 7. (*Non Temnopleurus Reynaudi* L. Agassiz.)

*Temnopleurus Reevesii* Mortensen, 1904, "Siam" Echinoidea, p. 62, pl. vi, figs. 3, 10, 12, pl. vii, fig. 37; H. L. Clark, 1925, Cat. Rec. Sea-Urchins Brit. Mus., p. 81.

Occurrence:

St. 24, 9.x.1933, 11° 54′ N., 51° 13′ E., 73–200 m., off Cape Gardafui. 1 young specimen.

Although the colour of this specimen is more green than usual, there can be no doubt that it is really *T. Reevesii*. The species having been found also off the Natal coast and south of the Agulhas Bank, this new locality indicates that it must occur all along the East African coast, in spite of its having been so rarely recorded from there. Also from the Indian Ocean in general it is only rarely recorded, *e. g.* it has not been taken by the "Investigator".

*Temnopleurus apodus* (A. Agassiz & H. L. Clark).

*Genocidaris apoda* H. L. Clark, 1912, Hawaiian Echini. Pedinidæ . . . Echinometridæ, p. 297, pl. xciii, figs. 16, 17; pl. c, figs. 1–3.

Occurrence:

St. 106, 12.i.1934, 5° 38′ 54″ S., 39° 15′ 42″ E., Pemba Strait, 212 m. 5 specimens.

This species has till now been recorded only from the Japanese seas. I have, however, taken specimens at the Kei Islands (1922), and in the Bali Sea (1929). The occurrence in the Pemba Strait is proof that it must be distributed all over the Indian Ocean, in the warmer regions and at suitable depths. That it has nothing to do with the genus *Genocidaris*, but must be referred to the genus *Temnopleurus*, close to the species *T. Reevesii*, will be shown in the forthcoming Vol. III of my Monograph of the Echinoidea.

*Temnotrema siamense* (Mrtsn.).

*Pleurechinus siamensis* Mortensen, 1904, "Siam" Echinoidea, p. 79, pl. i, figs. 2, 7, 11, 20, pl. ii, figs. 2, 9, 14, 15, 22, pl. vi, figs. 16, 36, and pl. vii, figs. 14, 44, 53.

*Temnotrema siamensis* H. L. Clark, 1912, Hawaiian Echini. Pedinidæ . . . Echinometridæ, p. 318; 1925, Cat. Rec. Sea-Urchins Brit. Mus., p. 92.

*Temnotrema siamense* Koehler, 1927, "Investigator" Echinoidea, III, p. 93, pl. xiv, figs. 11, 14.

Occurrence:

MB. IIc, 28.x.1933, 29 m., S. Coast of Arabia, off Kuria Muria Is. 2 specimens.

St. 27, 12.x.1933, 11° 57′ N., 50° 39′ E., 37–91 m., off Cape Gardafui. 1 specimen.

St. 111, 14.i.1934, 5° 04′ S., 39° 14′ E., 73–165 m., Pemba Strait. 1 specimen.

Descriptive Notes.—The specimen from the Pemba Strait is unusually large, 11 mm. horizontal diameter (12 mm. being the record size). It is light cream-coloured and looks rather unusually short-spined, which is due to the fact that the primary spines have been damaged in one way or another and then regenerated, though not quite normally;

the point of these spines therefore does not show the little terminal swelling characteristic of *T. siamense*; still I see no reason to doubt that it really belongs to this species, so variable in regard to colour.

The specimen from St. 27 is of a beautiful red colour, and belongs to the var. *pulchellum*.

The species was till now not known to occur on the East African coast; but there can be no doubt that it will prove to be widely distributed all along the coasts of the Indian Ocean within the tropical region.

### *Temnotrema scillæ* (Mazzetti).

*Pleurechinus scillæ* Mortensen, 1904, "Siam" Echinoidea, p. 86, pl. i, figs. 9, 10, 17, 18, pl. ii, figs. 4, 10, 12, 13, pl. vi fig. 13 and pl. vii, fig. 25.

*Temnotrema scillæ* H. L. Clark, 1912, Hawaiian Echini. Pedinidæ . . . Echinometridæ, p. 318; 1925, Cat. Rec. Sea-Urchins Brit. Mus., p. 91; Koehler, 1927, "Investigator" Echinoidea, III, p. 92, pl. xiv, fig. 12.

Occurrence:

St. 45, 29.x.1933, 18° 03′ N., 57° 02′ E., 38 m., off the S. Coast of Arabia. 9 specimens.

One of the specimens is broken, two are naked tests only, without the apical system; the main characters of the species being found only in the spines and the apical system, the identification of these two specimens cannot be quite definite, but there is, of course, no reason to doubt that they are of the same species as the other specimens together with which they were found.

### *Prionechinus Agassizi* Wood-Mason & Alcock.

*Prionechinus Agassizi* Wood-Mason & Alcock, 1891, Results of Deep-sea Dredging, 1890–91 ("Investigator"), Ann. Mag. Nat. Hist. (6), VIII, p. 441; Döderlein, 1906, Ech. d. Deutschen Tiefsee-Exped., p. 194, taf. xxiv, fig. 1, taf. xxv, fig. 7, taf. xlvi, fig. 1; H. L. Clark, 1912, Hawaiian Echini. Pedinidæ . . . Echinometridæ, p. 308; 1925, Cat. Rec. Sea-Urchins Brit. Mus., p. 78; Koehler, 1927, "Investigator" Echinoidea, III, p. 89, pl. xv, figs. 1, 2.

Occurrence:

St. 107, 12.i.1934, 5° 15′ 30″ S., 39° 33′ E., 421–457 m., Pemba Strait. 2 specimens, of 5 and 4 mm. diameter.

St. 109, 17.i.1934, 5° 11′ S., 39° 34′ E., 640 m., Pemba Strait. 1 specimen, 3 mm. diameter.

Descriptive Notes.—The largest specimen carries a parasitic gastropod (*Mucronalia*) on the aboral side. The fact that the apical system is somewhat elevated in this specimen is no doubt an anomaly due to the parasite, the same anomalous elevation of the aboral part of the test being also found in specimens of *Salmacis* infested with this parasitic Gastropod.

The youngest specimen has still only one tube-foot in each pair of buccal plates. In the two specimens from St. 107 the mouth is widely open, so that one looks directly into the œsophagus. In the largest specimen the buccal tube-feet are quite conspicuous on account of the sucking disc being brownish; also the other tube-feet show a faint indication of the same colour.

## DESCRIPTION OF PLATE I.

FIG. 1.—*Goniocidaris indica* ; partly denuded. Aboral side.
FIG. 2.—*Goniocidaris indica* ; partly denunded. Oral side.
FIG. 3.—*Goniocidaris indica* ; partly denuded. Side view.
FIG. 4.—*Goniocidaris indica*. Aboral side.
FIG. 5.—*Cidaris mabahissæ* ; partly denuded. Aboral side.
FIG. 6.—*Cidaris mabahissæ* ; partly denuded. Oral side.

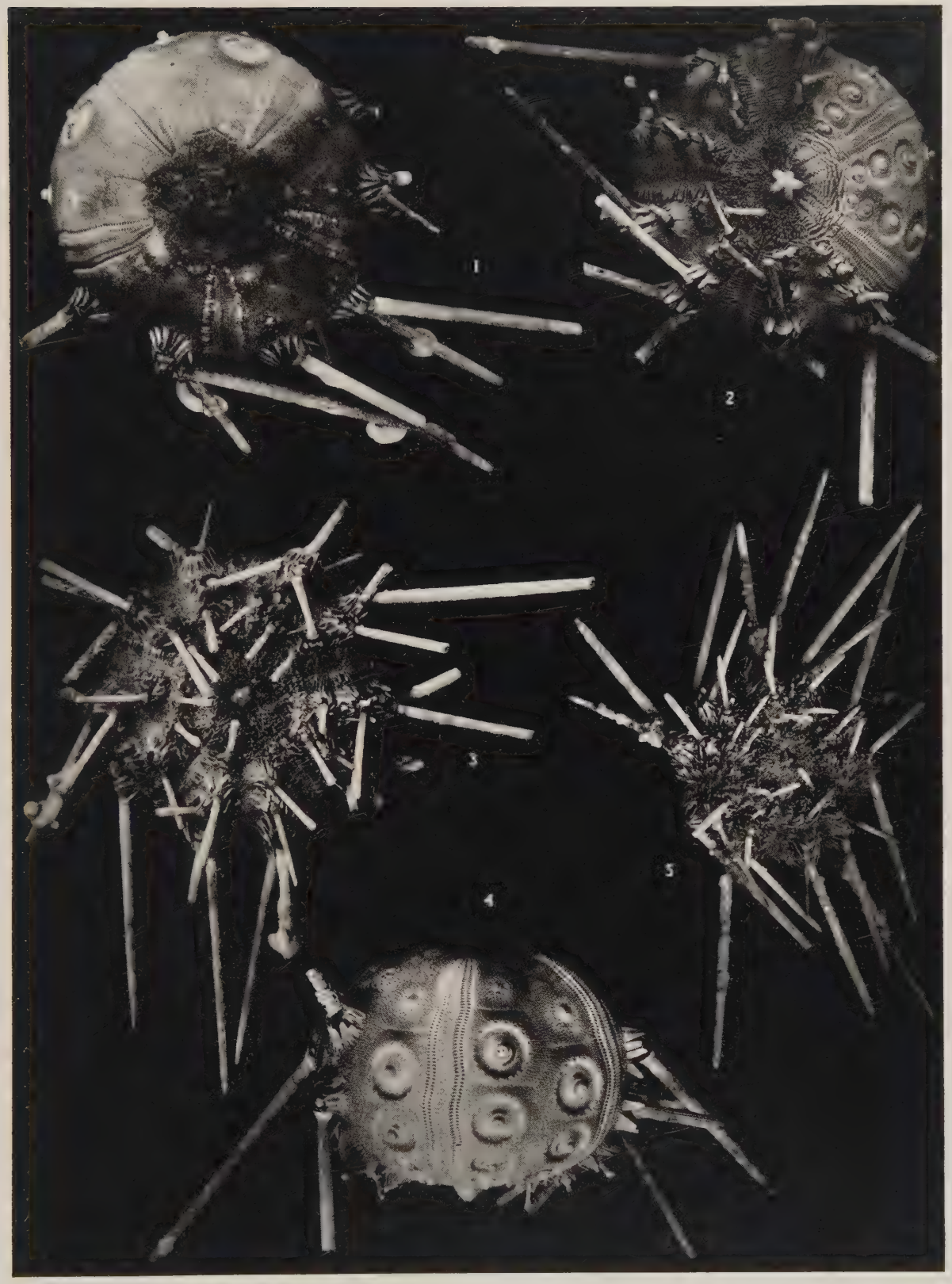
All figures natural size.

[*Adlard & Son, Ltd., Impr.*

## DESCRIPTION OF PLATE II.

FIG. 1.—*Stereocidaris reducta*; partly denuded. Aboral side.
FIG. 2.—*Stereocidaris reducta*; partly denuded. Oral side.
FIG. 3.—*Stereocidaris reducta*. Oral side.
FIG. 4.—*Stereocidaris reducta*; partly denuded. Side view.
FIG. 5.—*Stylocidaris lævispina*. Oral side.

All figures natural size.

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## DESCRIPTION OF PLATE III.

FIG. 1.—*Lissocidaris fusca.* Aboral side.
FIG. 2.—*Lissocidaris fusca.* Oral side.
FIG. 3.—*Lissocidaris fusca.* Side view.

All figures natural size.

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## DESCRIPTION OF PLATE IV.

FIG. 1.—*Stylocidaris lævispina.* Aboral side.
FIG. 2.—*Stereocidaris squamosa* ; partly denuded. Aboral side.
FIG. 3.—*Stereocidaris squamosa* ; same specimen. Oral side.
FIG. 4.—*Cidaris mabahissæ ;* partly denuded. Side view.
FIG. 5.—*Stylocidaris lævispina* ; partly denuded. Side view.

All figures natural size.

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## DESCRIPTION OF PLATE V.

Fig. 1.—Part of ambulacrum of *Stereocidaris reducta*. × 12.
Fig. 2.— ,, ,, *Lissocidaris fusca*. × 12.
Fig. 3.— ,, ,, *Acanthocidaris curvatispinis*. × 12.
Fig. 4.— ,, ,, *Goniocidaris indica*. × 12.
Fig. 5.— ,, ,, *Cidaris mabahissæ*. × 12.
Fig. 6.— ,, ,, *Stylocidaris lævispina*. × 12.
Fig. 7.—Valve of large tridentate pedicellaria of *Goniocidaris indica*. × 85.
Fig. 8.—Terminal part of primary oral spine of *Tromikosoma* (*?*) *uranus*. × 23.

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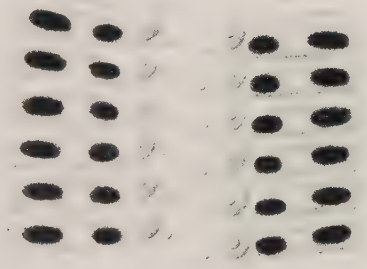

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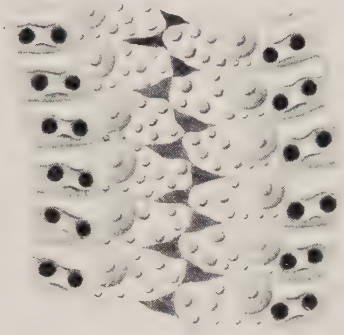

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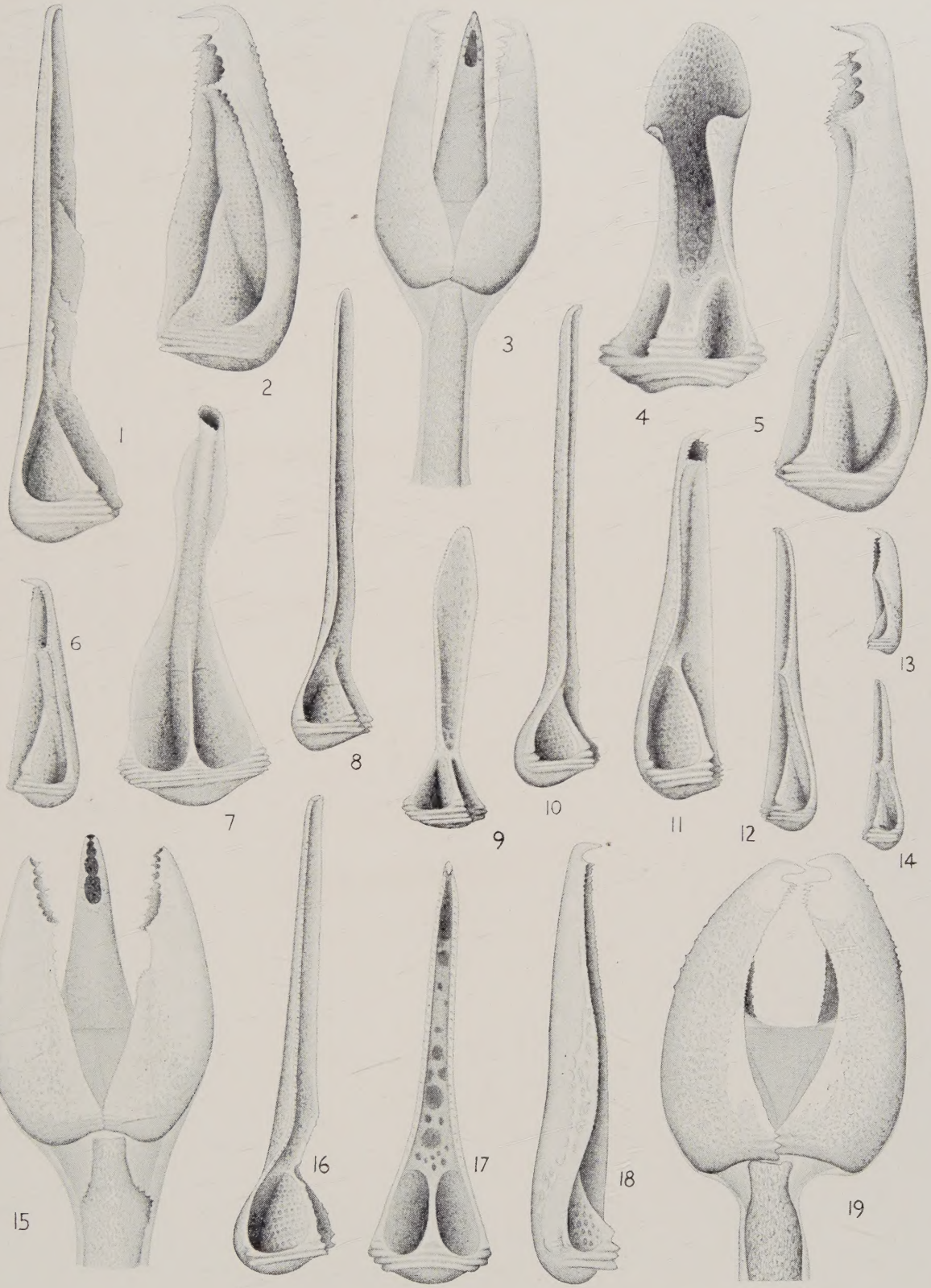
## DESCRIPTION OF PLATE VI.

FIG. 1.—Valve of tridentate pedicellaria of *Lissocidaris fusca.* × 65.
FIG. 2.— ,, large globiferous pedicellaria of *Lissocidaris fusca.* × 75.
FIG. 3.—Large globiferous pedicellaria of *Cidaris mabahissæ.* × 45.
FIG. 4.—Valve of tridentate pedicellaria of *Phormosoma verticillatum.* × 85.
FIG. 5.— ,, large globiferous pedicellaria of *Cidaris mabahissæ.* × 75.
FIG. 6.— ,, small globiferous pedicellaria of *Lissocidaris fusca.* × 85.
FIG. 7.— ,, globiferous pedicellaria of *Stylocidaris lævispina.* × 60.
FIG. 8.— ,, tridentate pedicellaria of *Cidaris mabahissæ.* × 45.
FIG. 9.— ,, tetradactylous pedicellaria of *Salenocidaris miliaris indica.* × 85.
FIG. 10.— ,, tridentate pedicellaria of *Stylocidaris lævispina.* × 60.
FIG. 11.— ,, small globiferous pedicellaria of *Stylocidaris lævispina.* × 60.
FIG. 12.— ,, ,, ,, ,, *Cidaris mabahissæ.* × 75.
FIG. 13.— ,, ,, ,, ,, *Cidaris mabahissæ.* × 85.
FIG. 14.— ,, ,, ,, ,, *Stereocidaris reducta.* × 85.
FIG. 15.—Large globiferous pedicellaria of *Stereocidaris reducta.* × 85.
FIG. 16.—Valve of tridentate pedicellaria of *Stereocidaris reducta.* × 85.
FIG. 17.— ,, globiferous pedicellaria of *Goniocidaris indica ;* from the inside. × 165.
FIG. 18.— ,, ,, ,, *Goniocidaris indica ;* side view. × 165.
FIG. 19.—Two-valved large globiferous pedicellaria of *Lissocidaris fusca.* × 65.

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